Development of Vapor Phase Hydrogen Peroxide Sterilization Process

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In order to meet mission category IVB microbial reduction requirements for all Mars in-situ life detection and sample return missions, entire planetary spacecraft (including planetary entry probes and planetary landing capsules) may have to be exposed to a qualified sterilization process. This process could be the elevated temperature dry heat sterilization process (~115°C for 40 hours) which was used to sterilize Viking spacecraft. However, with utilization of highly sophisticated electronics and sensors in modern spacecraft, this process may no longer be acceptable to design engineers to achieve terminal sterilization of entire spacecraft. An alternative technique is a commercially available low temperature (~45°C) vapor phase hydrogen peroxide sterilization process generally used by the medical industry. The effectiveness of this second process is well established at a technology readiness level (TRL) of 3.

To effectively and safely apply this technology to sterilize a spacecraft, which is made out of various man-made materials and electronic circuit boards, the following issues still need to be addressed.

1. Diffusion of H_2O_2 under sterilization process conditions into mated and geometrically challenging surfaces.
2. Materials and components compatibility with the sterilization process.
3. Develop methodology to protect (isolate) sensitive electronic components from H_2O_2 vapor.

This paper will include discussion on the work we are conducting at JPL to address these issues